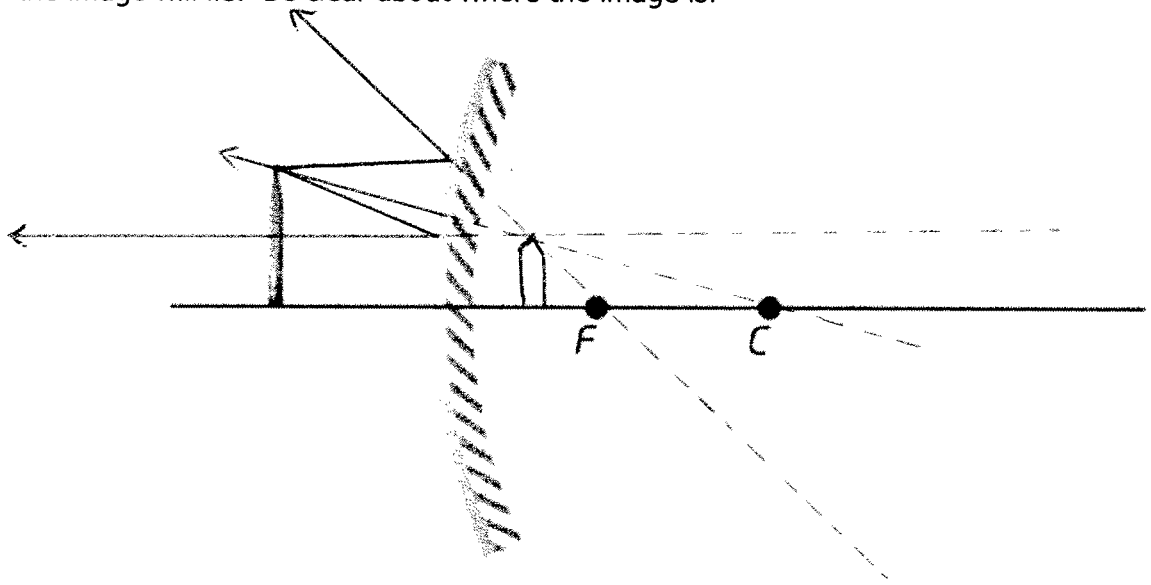

Name: Answers Date: _____

MCR3U

Unit 4 Test: Optics

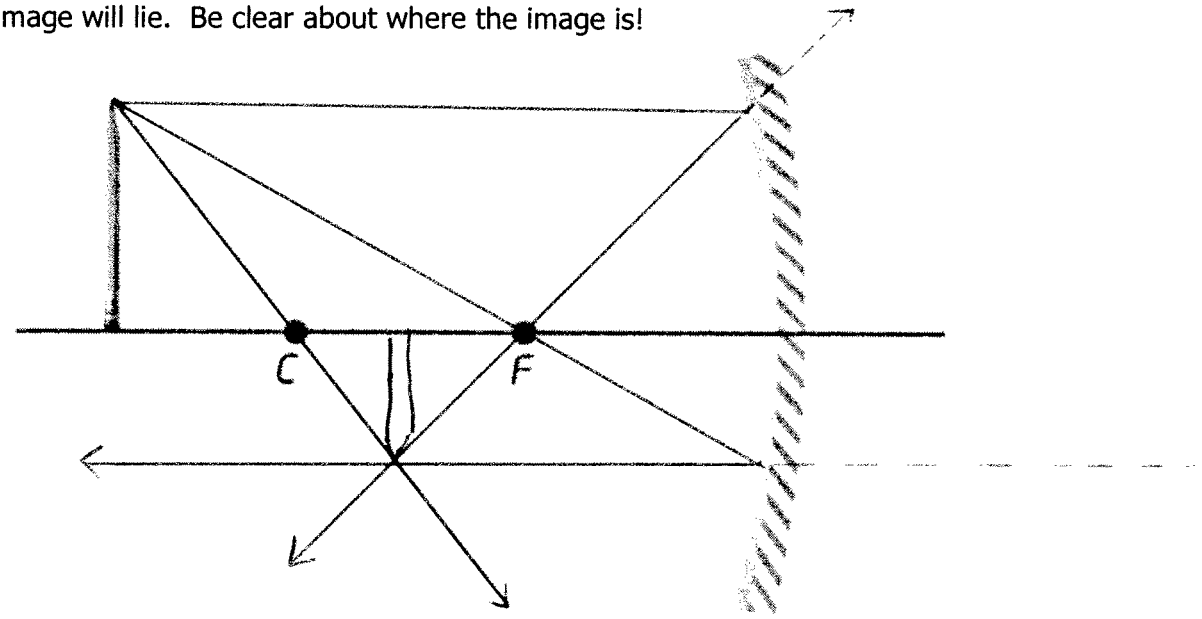
/4 K

1. Using the diagram below, draw the appropriate incident and reflected rays to help you predict where the image will lie. Be clear about where the image is!



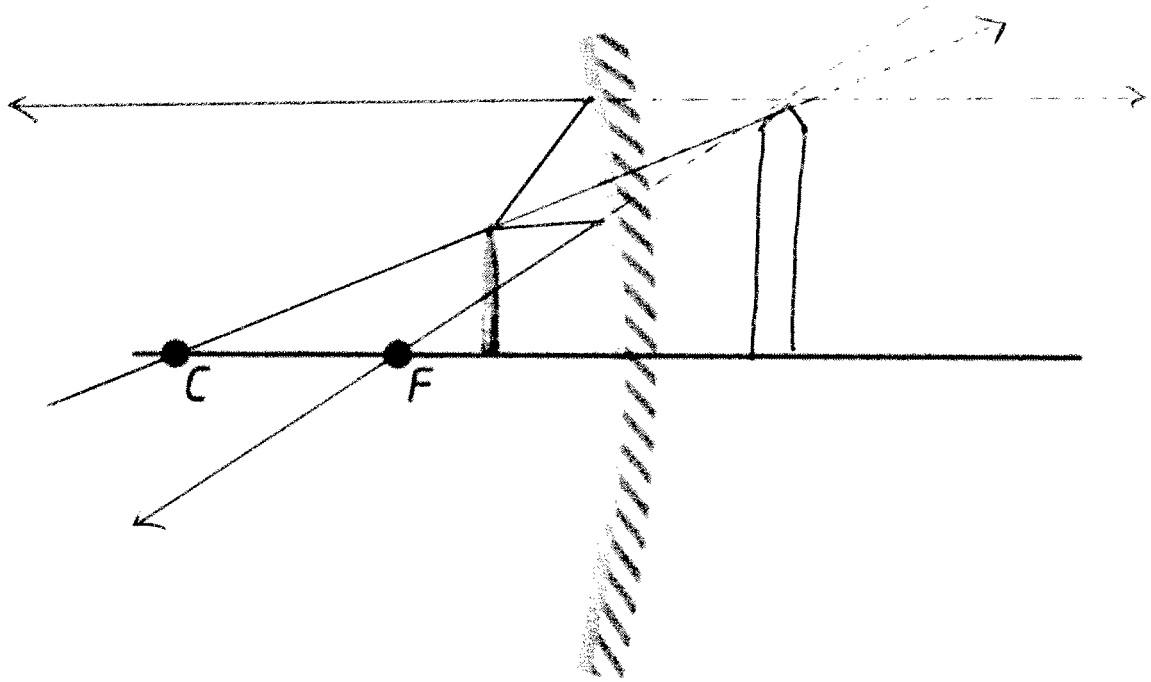
/4 K

2. a) Using the diagram below, draw the appropriate incident and reflected rays to help you predict where the image will lie. Be clear about where the image is!



/4
A

3. Using the diagram below, draw the appropriate incident and reflected rays to help you predict where the image will lie. Be clear about where the image is!



/3
A

4. The mirror shown above, has f = 8 cm. The pencil (4-cm tall) is placed 6 cm from the mirror.

a) Use the mirror equation to find the image distance.

$$\frac{1}{f} = \frac{1}{d_i} + \frac{1}{d_o}$$

$$\frac{1}{8} = \frac{1}{d_i} + \frac{1}{6}$$

$$\frac{1}{d_i} = -0.04167$$

$$d_i = \frac{1}{-0.04167} = -24 \text{ cm}$$

$$0.125 = \frac{1}{d_i} + 0.166$$

b) Why is the image distance negative?

Virtual / behind mirror

/2
C

c) The image height in this question is **positive.** Is the image upside-down or right-side-up?

Right-side-up

/8 K

5. Define each of the following terms.

Chemiluminescence	light from a chemical reaction
Gamma Rays	strongest ray of light
Incandescence	light that gets hot
Refraction	light going through an object instead of reflecting
Virtual Image	the image on the other side of the mirror (reflected) OR
Bioluminescence	light from living things
Convex Mirror	Mirror that curves outwards
Phosphor	the coating in an electric discharge. allows UV light to be seen, when combined with excited Mercury electrons.

/5 T

6. A 10-cm tall apple sits 20 cm away from a concave mirror with f = 15 cm.

a) What is the image distance?

$\frac{1}{15} = \frac{1}{d_i} + \frac{1}{20}$

$0.0666 - 0.05 = \frac{1}{d_i}$

$0.0166 = \frac{1}{d_i}$

$60.2409 = d_i$

The image distance is 60.2409 cm

Nice

b) What is the image height?

$\frac{h_i}{h_o} = \frac{-d_i}{d_o}$ $\frac{h_i}{10} = \frac{-60.2409}{20}$

$\frac{h_i}{10} = -3.0120$

$h_i = -3.0120\,(10)$

$h_i = -30.12$

the image height is -30.12 cm

2/2 C

7. Explain how total internal reflection is used in fibre optic cables.

fibre optic cables is a tube of glass that light travels through. They bounce of the side of the glass instead of refracting through due to internal reflection.

well said

2/2 C

8. Explain how **rainbows** form immediately after a rainstorm. Use the term **index of refraction.**

rain droplets in the air have light from the sun refract through the droplet due to index of refrac The light then bounces of the inner surface of the droplet then refracts through it leaving the droplet as different light ~~passes~~ through. the droplets are at different heights giving the colors of the rainbow layers.

3/3 C

9. Imagine that you and a friend are hiking across a hot desert. Your friend believes that he sees a pool of water and starts to run towards the water. How could you convince your friend not to exert himself unnecessarily? In your explanation, include a description of the different indices of refraction of the layers of air of different temperatures.

Put another way: Explain how mirages form.

When the ground of sand or pavement gets very hot the heat above the ground warms up. Now the air is different temperatures. The heat right above the ground is very hot, while the air further up is midely hot. When the suns rays pass through and hits the air above the ~~sun~~ ground it refracts through causing a Mirage.

/2 A

10. What is the speed of light in a medium with n = 1.56?

$$n = \frac{c}{v}$$

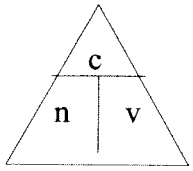
$$v = \frac{c}{n} = \frac{3.0 \times 10^8 \text{ m/s}}{1.56} = 1.92 \times 10^8 \text{ m/s}$$

/2 A

11. What is the index of refraction if the speed of light in the medium is $1.77 \times 10^8 \text{ m/s}$

$$n = \frac{c}{v} = \frac{3.0 \times 10^8 \text{ m/s}}{1.77 \times 10^8 \text{ m/s}} = 1.69$$

Formulas $n = \frac{c}{v}$ $c = 3.0 \times 10^8$ m/s



Mirror Equation

$$\frac{1}{f} = \frac{1}{d_i} + \frac{1}{d_o}$$

f is the focal length (negative for convex mirror

d_o is the object distance (how fa the actual object is from the mirror)

d_i is the image distance (how far the image of the object is from the mirror). Negative if the image is behind the mirror.

$$f = \frac{d_i + d_o}{d_i d_o}$$

$$d_i = \frac{d_o - f}{d_o f}$$

$$d_o = \frac{d_i - f}{d_i f}$$

Magnification Equation

$$m = \frac{h_i}{h_o} = \frac{-d_i}{d_o}$$

m is the magnification

d_o is the object distance

d_i is the image distance (negative if the image is behind the mirror)

h_o is the object height

h_i is the image height (negative if the image is inverted)

$$h_i = \frac{-d_i h_o}{d_o} \qquad h_o = \frac{-h_i d_o}{d_i}$$

$$d_i = \frac{-h_i d_o}{h_o} \qquad d_o = \frac{-d_i h_o}{h_i}$$